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CLAIMS

1. A method of spraying particles
which comprises applying a voltage of the same polarity
5 as the particle charge polarity to a plurality of electrodes
formed on a substrate
and spraying the particles while utilizing a repulsive
force operating on the particles,
wherein means is employed for preventing said particles
10 from being turned out of the electrode domain comprising the
plurality of electrodes.

2. The method of spraying particles according to Claim
1,
15 which comprises providing at least one dummy electrode
outside the electrode domain comprising the plurality of
electrodes,
and applying, to said dummy electrode, a voltage of the
same polarity as the particle charge polarity to thereby control
20 the electric field above the peripheral region of the electrode
domain comprising said plurality of electrodes.

3. The method of spraying particles according to Claim
1 or 2,
25 wherein the voltage applied to the plurality of
electrodes is 500 to 8,000 V.

4. The method of spraying particles according to Claim
1, 2 or 3,
30 wherein a voltage having the same polarity as the particle
charge polarity is applied to at least one electrode other than
said plurality of electrodes, on the substrate in a region at
least partly surrounding the periphery of the electrode domain
comprising the plurality of electrodes.

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5. The method of spraying particles according to Claim 1, 2, 3 or 4,

wherein the electrode other than the plurality of electrodes is disposed in a region surrounding the periphery of the electrode domain other than an accessory electrode for voltage application to said plurality of electrodes.

6. The method of spraying particles according to Claim 1, 2, 3, 4 or 5,

wherein the area of the electrode other than the plurality of electrodes is larger than the area of any of said plurality of electrodes.

7. The method of spraying particles according to Claim 1, 2, 3, 4, 5 or 6,

wherein the voltage applied to the electrode other than the plurality of electrodes is the same as that applied to said plurality of electrodes.

8. The method of spraying particles according to Claim 4, 5, 6 or 7,

wherein the electrode other than the plurality of electrodes is a solid electrode provided in the periphery region of the substrate.

9. The method of spraying particles according to Claim 1, 2, 3, 4, 5, 6, 7 or 8,

wherein the particles are sprayed by dry method.

10. A method for producing a liquid crystal display device comprising

spraying spacers onto at least one of a first substrate comprising at least pattern-forming transparent electrodes and having at least one display area and a second substrate to be disposed opposedly above the first substrate

and filling a liquid crystal into the space between both the substrates,

wherein, in providing accessory electrodes outside the display area and spraying positively or negatively charged spacers onto the substrate, two or more voltages differing in voltage value are applied to respective transparent electrodes and a voltage is applied to the accessory electrodes as well to thereby control the electric field generated above the transparent electrodes and above the accessory electrodes so as to cause selective spacer disposition only in a predetermined transparent electrode gap among the gaps between respective neighboring transparent electrodes.

11. The method for producing a liquid crystal display device according to Claim 10,

wherein the predetermined transparent electrode gap in which spacers are to be disposed selectively is provided between the respective transparent electrodes to which one and the same voltage is applied.

12. The method for producing a liquid crystal display device according to Claim 11,

wherein, when the spacers are positively charged, the predetermined transparent electrode gap in which spacers are to be disposed selectively is provided between the respective transparent electrodes to which the lowest of the two or more voltages differing in value applied to the transparent electrodes is applied

and, when the spacers are negatively charged, the electrode gap is provided between the respective transparent electrodes to which the highest of the two or more voltages differing in value applied to the transparent electrodes is applied.

13. The method for producing a liquid crystal display

device according to Claim 12,

wherein the two or more voltages differing in voltage value which are applied to the transparent electrodes have the same polarity as the polarity of the voltage for charging
5 spacers.

14. The method for producing a liquid crystal display device according to Claim 10, 11, 12 or 13,

wherein the polarity of the voltage applied to the
10 accessory electrodes is selected so that a repulsive force may be exerted on the spacers, when the electric field as formed above the whole region which comprises the transparent electrodes, exerts a repulsive force on the spacers,

and the polarity of the voltage applied to the accessory
15 electrodes is selected so that an attractive force may be exerted on the spacers, when the electric field as formed above the whole region which comprises the transparent electrodes, exerts an attractive force on the spacers.

20 15. The method for producing a liquid crystal display device according to Claim 14,

wherein the voltage applied to the accessory electrodes is identical with the voltage exerting the greatest repulsive or attractive force on the spacers among the two or more voltages
25 differing in voltage value as applied to the transparent electrode.

16. The method for producing a liquid crystal display device according to Claim 10, 11, 12, 13, 14 or 15,

30 wherein the transparent electrodes are stripe-shaped, and the accessory electrodes are disposed in parallel with the longer sides of the transparent electrodes.

17. The method for producing a liquid crystal display
35 device according to Claim 10, 11, 12, 13, 14, 15 or 16,

wherein the accessory electrodes are provided in almost the same electrode pattern as the transparent electrodes.

18. The method for producing a liquid crystal display device according to Claim 10, 11, 12, 13, 14, 15 or 16, wherein the accessory electrodes are dummy electrodes provided for reducing the transparent electrode-due level difference.

19. The method for producing a liquid crystal display device according to Claim 10, 11, 12, 13, 14, 15, 16, 17 or 18, wherein the accessory electrodes are dummy electrodes not applying display voltage thereto.

20. A method for producing a liquid crystal display device comprising spraying spacers onto at least one of a first substrate comprising at least pattern-forming transparent electrodes and a dummy electrode and a second substrate to be disposed opposedly above the first substrate and filling a liquid crystal into the space between both the substrates, wherein, in spraying positively or negatively charged spacers onto the substrate, two or more voltages differing in voltage value are applied to respective transparent electrodes and the dummy electrode as well,

the predetermined transparent electrode gaps in which spacers are to be selectively disposed are provided between respective two neighboring transparent electrodes,

the number of transparent electrodes is even, and the two or more voltages differing in value are applied in a manner such that when the spacer charge polarity is positive (+), the lowest of the two or more voltages differing in value is applied to the respective two neighboring transparent electrodes between which spacers are to be disposed

in the middle, and when the spacer charge polarity is negative (-), the highest of the two or more voltages differing in value is applied to the respective two neighboring transparent electrodes between which spacers are to be disposed in the middle.

21. The method for producing a liquid crystal display device according to Claim 20,

wherein the voltage applied to a dummy electrode is within the range of the highest and lowest voltages among the two or more voltages differing in voltage as applied to the transparent electrodes.

22. The method for producing a liquid crystal display device according to Claim 20 or 21,

wherein, in cases where the spacer charge polarity is negative (-), the voltage application to the transparent electrodes is carried out by providing a common conductor line (A) connected with one of the two ends of each transparent electrode to which the highest voltage is to be applied, and applying the highest voltage by means of the conductor line (A), while providing a common conductor line (B) connected with one end, on the opposite side of the one end mentioned above, of the two ends of each transparent electrode to which a lower voltage is to be applied, and applying the voltage by means of the conductor line (B)

and, in cases where the spacer charge polarity is positive (+), the voltage application to the transparent electrodes is carried out by providing a common conductor line (A) connected with one of the two ends of each transparent electrode to which the lowest voltage is to be applied and applying the voltage by means of the conductor line (A), while providing a common conductor line (B) connected with one end, on the opposite side of the one end mentioned above, of the two ends of each transparent electrode to which a higher voltage is to be applied

and applying the higher voltage by means of the conductor line (B).

23. The method for producing a liquid crystal display
5 device according to Claim 22,

wherein the voltage application to a dummy electrode is carried out by connecting the dummy electrode with either the conductor line (A) or the conductor line (B).

10 24. The method for producing a liquid crystal display device according to Claim 20, 21 or 22,

wherein the voltage application to dummy electrodes is carried out by connecting all dummy electrodes formed on the substrate with one another.

15 25. A method for producing a liquid crystal display device comprising

spraying spacers onto at least one of a first substrate comprising at least pattern-forming transparent electrodes and
20 a dummy electrode and a second substrate to be disposed opposedly above the first substrate

and filling a liquid crystal into the space between both the substrates,

25 wherein, in spraying positively or negatively charged spacers onto the substrate, the substrate is disposed in close contact with an earthed conductive stage, and

a conductor is provided in a state electrically insulated from the conductive stage,

30 said conductor being a conductive frame having an opening,

said conductor frame being disposed on the periphery of the substrate with or without partial overlapping with the substrate periphery,

35 and wherein a voltage is applied to the transparent electrodes and the conductive frame.

26. The method for producing a liquid crystal display device according to Claim 25,

wherein the substrate has a transparent electrode as well
5 as a dummy electrode

and, in spraying positively or negatively charged spacers onto the substrate, a voltage is applied to the transparent electrodes, the dummy electrode, and to a conductive frame.

10 27. The method for producing a liquid crystal display device according to Claim 26,

wherein the dummy electrode are connected with the transparent electrodes

and the voltage application to the dummy electrode is
15 carried out via the conductive frame.

28. The method for producing a liquid crystal display device according to Claim 27,

wherein the voltage applied to the conductive frame is
20 different from the voltage applied to the transparent electrodes.

29. A method for producing a liquid crystal display device comprising

25 spraying spacers onto at least one of a first substrate comprising at least pattern-forming transparent electrodes and an alignment layer and having at least one display area and a second substrate to be disposed opposedly above the first substrate

30 and filling a liquid crystal into the space between both the substrates,

wherein, in spraying positively or negatively charged spacers onto the substrate, the substrate is disposed in close contact with an earthed conductive stage,

35 a voltage having the same polarity as the spacer charge

polarity is applied to the transparent electrodes on the substrate,

a conductor is provided, outside the display area, in a state electrically isolated from the conductive stage,

5 and a voltage having the same polarity as the polarity of the voltage applied to the transparent electrodes is applied to the conductor to thereby form almost the same electric field within and without the substrate.

10 30. The method for producing a liquid crystal display device according to Claim 29,

wherein the conductor is larger in outermost size than the substrate, and is a conductive frame having an opening not greater than the substrate size,

15 said conductive frame being disposed with or without overlapping with the periphery of the substrate,

and wherein a voltage of the same polarity as that applied to the transparent electrodes is applied to the conductive frame.

20

31. The method for producing a liquid crystal display device according to Claim 29 or 30,

25 wherein the conductive stage has a size not greater than the substrate size but extending to the area outside the parting lines

and the upper surface of the conductive frame is disposed on the almost same plane as the conductive stage surface or at a level lower than the same.

30

32. The method for producing a liquid crystal display device according to Claim 29, 30 or 31,

wherein the conductive stage has a size not greater than the substrate size but extending to the area outside the parting lines,

35

the conductive frame is formed so as to extend from the

area outside the parting lines to the outside of the substrate,
and the area occupied by the conductive stage and that
by the conductive frame in the area outside the parting lines
satisfies the relation:

5 [area occupied by conductive stage] > [area occupied by
conductive frame].

33. The method for producing a liquid crystal display
device according to Claim 29, 30 or 31,

10 wherein the conductive stage has a size not greater than
the substrate size but extending to the area outside the parting
lines

and the conductive frame is formed outside the transparent
electrodes without any overlapping with the area outside the
15 parting lines.

34. The method for producing a liquid crystal display
device according to Claim 29, 30 or 31,

20 wherein the conductive stage is substantially identical
in size with the range of occurrence of the transparent
electrodes

and the conductive frame is formed by areas where no
transparent electrodes are present.

25 35. A method for producing a liquid crystal display
device comprising

spraying spacers onto at least one of a first substrate
comprising at least pattern-forming transparent electrodes and
an alignment layer and having one or more display areas and a
30 second substrate to be disposed opposedly above the first
substrate

and filling a liquid crystal into the space between both
the substrates,

wherein, in spraying positively or negatively charged
35 spacers onto the substrate, the substrate is disposed in close

contact with an earthed conductive stage smaller in size than the substrate to allow the substrate periphery to be apart from the conductive stage,

and a voltage of the same polarity as the spacer charge polarity is applied to the transparent electrodes on the substrate.

36. The method for producing a liquid crystal display device according to Claim 35,

wherein the substrate onto which spacers are to be sprayed has a black matrix formed thereon,

the black matrix is conductive,

and the conductive stage comprises one or more units each smaller in size than the picture frame periphery of the black matrix of each display area on the substrate.

37. The method for producing a liquid crystal display device according to Claim 35 or 36,

wherein the area of contact between the conductive stage and the substrate is not less than 30% of the display area area.

38. A particle sprayer for disposing charged particles selectively on a substrate having a plurality of electrodes

which comprises a nozzle for spraying charged particles onto the substrate,

a conductive stage having a fixed position and serving to hold the substrate onto which charged particles are to be sprayed,

a plurality of push-up pins for mounting the substrate on and dismounting the substrate from the conductive stage,

a probe for applying a voltage identical in polarity with the charged particles to a plurality of electrodes on the substrate disposed on the conductive stage,

and a conductor is electrically insulated from the conductive stage,

said conductor being a conductive frame provided with an opening smaller in size than the substrate,

being disposed on the top of the substrate disposed on the conductive stage,

5 and being applied a voltage of the same polarity as the charged particle polarity thereto.

39. The particle sprayer according to Claim 38,
wherein the probe and the conductor move up or down in
10 synchronization with each other.

40. The particle sprayer according to Claim 38,
wherein the probe and the conductor move up or down as
an integrated body.

15 41. The particle sprayer according to Claim 38, 39 or 40,
wherein the probe, conductor and push-up pins are driven
in synchronization by means of a single driving source.

20 42. The particle sprayer according to Claim 38, 39, 40 or 41,
wherein one and the same voltage is applied
simultaneously to the plurality of electrodes and the
25 conductor.

43. A liquid crystal display device obtainable by the
method of spraying particles according to Claim 1, 2, 3, 4, 5,
6, 7, 8 or 9.

30 44. A liquid crystal display device obtainable by the
method for producing a liquid crystal display device according
to Claim 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,
23 or 24.

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45. A liquid crystal display device obtainable by the method for producing a liquid crystal display device according to Claim 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36 or 37 using the particle sprayer according to Claim 38, 39, 40, 41
5 or 42.